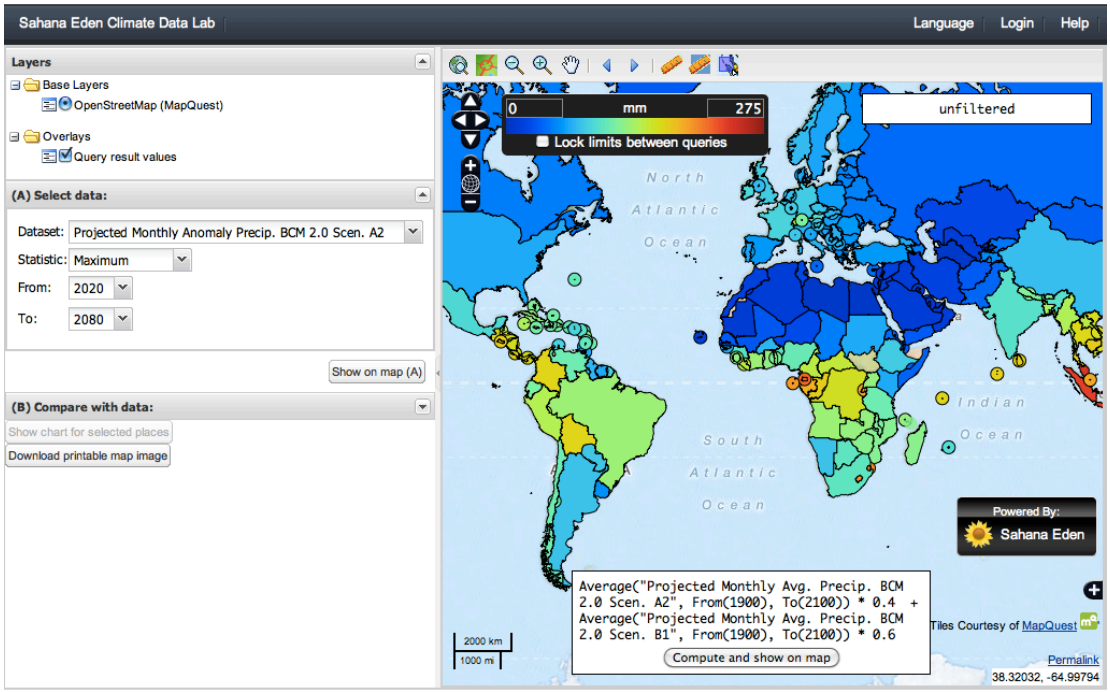

Sahana Eden Climate Data Lab

User Manual

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Disclaimer

The Sahana Eden Climate Data Lab is a software product designed to meet various requirements of various types of users. As such it may change in the future, and this manual cannot guarantee that it will adequately describe future versions. Also, screenshots in this manual may show user interface layouts and data set names that differ slightly to the live version.

Overview

Purpose / intent

The Sahana Eden Climate Data Lab is designed to facilitate the analysis of climate/meteorological, geographical and projection data using a publicly accessible web-based interface. Its intended audience are climate research scientists, meteorologists, hydrologists and anyone who needs to understand past and future (projected) weather patterns.

A useful way to see the Sahana Eden Climate Data Lab

To avoid confusion, it is useful to see the portal as essentially a somewhat sophisticated calculator with its own database. Its calculation results are maps, time-series charts, or downloadable data. Like a spreadsheet (which is another sophisticated calculator), it uses a simple language to represent arithmetic and statistical operations.

The point of this is, just like any calculator, it is *unintelligent* in the sense that it basically just *applies the instructions it is given to the data it has been given*. It isn't smart, i.e. ultimately it cannot recognise bad data or instructions although it *does have some mechanisms to cope with bad data* and it *can also use some meta-data (data about data) to help users validate results.*

For example, the portal can't and doesn't try to detect incorrect outliers, but the map overlay colours will visually and obviously show those outliers, and the user can edit the colour scale to exclude those outliers and see a useful map.

As another example, the system doesn't know what the values mean, but does know about units, so it can dimensionally analyse expressions and then show the output units. The portal will complain when units are incorrectly mixed in an expression.

Features

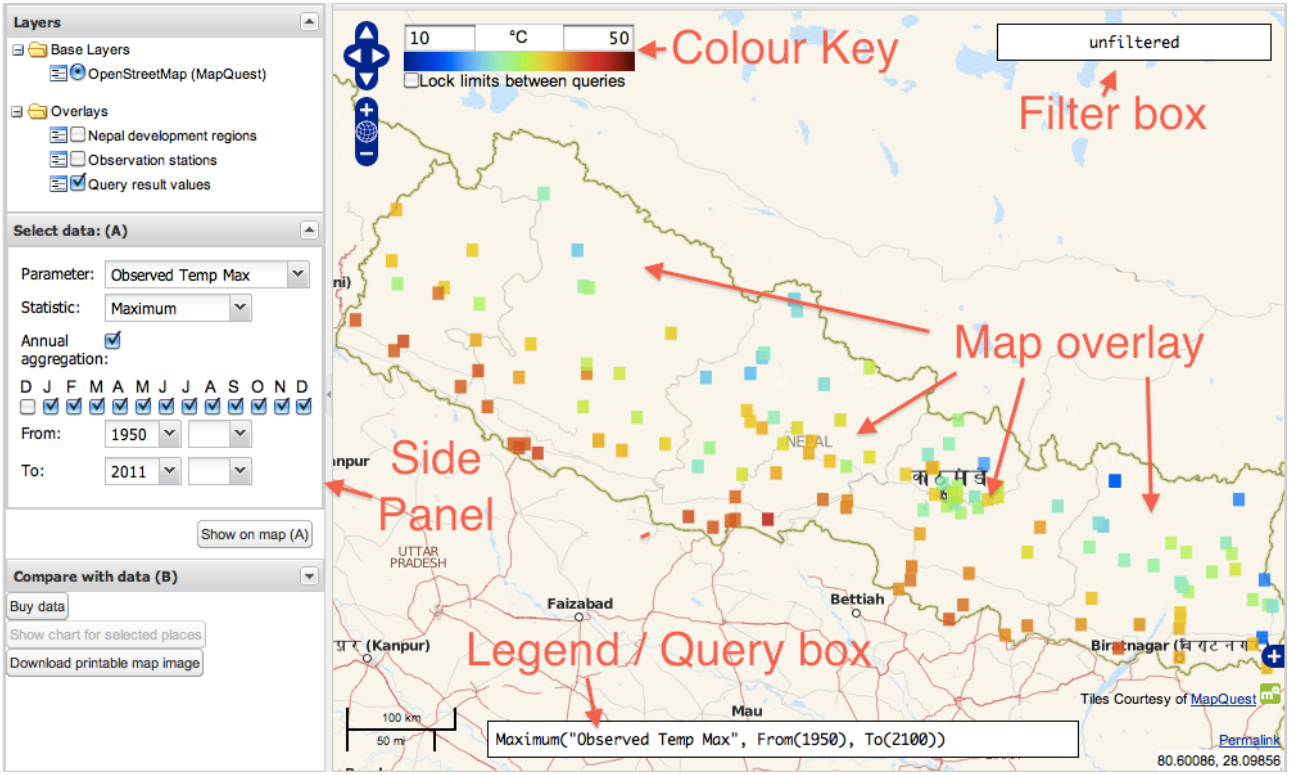
- Easy selection and display of:
    - Observed Station Data.
    - Observed Gridded Data.
    - Projected Data.
- Easy comparison of data
- Ability to aggregate data
- Flexible data queries, which allows more sophisticated data analysis by giving the user the ability to enter expressions.
- Dimensional and delta analysis of expressions to aid data validation
- Generation of time-series charts, with regression lines, and ability to combine and resize charts.
- Filtering map by places / values.
- Ability to show observation stations as a separate layer.
- Popup boxes to show values.
- Filtering of places shown on the map with shape files.
- Printable images of the map overlay
- Download of data.

Definitions

For clarity, certain terms are used with precise meanings in the rest of this document.

Name	Definition
Data	Sets of numeric values of a given variable, specifically: • at a particular place, • over a particular time range. Internally these are stored as positive numbers wherever possible. This is important These sets of data have associated units (e.g. mm for rainfall). These sets of data are stored in a database used by the Sahana Eden Climate Data Lab.
Place	A geographical position at a fixed latitude and longitude. Places may or may not be observation stations. Places may or may not have other attributes including: elevation, name, station ID, and a list of regions the place is inside. These attributes may be used in filtering.
Observation Station	A real weather observation station. These usually have names and elevation information.

Tour of the User interface



Map view components

Component	Purpose	Description / notes
Map overlay	Shows values above the base map layer.	Values from the query are shown as coloured squares.
Legend / Query box	Controls the data being shown in the map overlay.	
Filter box	Place/value based filtering of the map overlay	Can filter based on any attribute, e.g. elevation > 1000
Colour Key	Control the colours shown in the map overlay.	This is set to sensible values from the query data. It is also editable, and lockable.

Side panel components

Component	Purpose	Description / notes
Layers	Toggle visible map layers	
Select Data: (A)	Easily generates a query to display data.	
Compare with data (B)	Easily generates a query to compare data.	Used together with Select Data: (A)
Show chart for selected places.	Show a time-series chart for selected	Places on the map overlay need to be selected to enable this button.
Download printable map image	Downloads a generated (server-side) PNG image of the map.	Side panel and unnecessary map widgets will not appear on the image.

Climate Data

Types of data available

Three main types of data are available. It is important to understand the distinctions between and the limitations of these types in order to interpret the data from the system properly.

Type name	Explanation	Details and Limitations
Observed	Data that has been collected at various observation stations in The World. It has not been interpolated or generated.	Some areas of The World have better station coverage than others. Some stations have been collecting data for a longer period of time. Some types of data may not be available at certain points in time. E.g. some stations have not been collecting rainfall data for as long as they have been collecting temperature data. Some data may be incorrect due to misreported data or temporary faults in equipment. Coloured square size remains constant while zooming in or out.
Observed Gridded	Data that has been interpolated from the observed data into a grid of points on the map. A grid is an arbitrary collection of places on the map. I.e. the system is flexible in whatever grid pattern is used.	Grid sizes may be different. This is important to understand when comparing data. Data are compared by place. Interpolated data will have greater uncertainty the further it lies (geographically and temporally) from observed data. The places on the grid do not represent Observation Stations.
Projected	Projected Data has been produced using a variety of different climate models and emissions scenarios. This is also given on a grid.	These projections are produced by third parties outside the system. The mechanism of producing these projections is too technical to describe here. Please refer to the documentation for the model used in the projection. Some projections may have long gaps in the data. For example, the earlier or baseline data can be used to compare the model against real observed/gridded data. The later data (e.g. 2030 -2060) can be used to make predictions.

Names and naming conventions

Data will always have a name. Names will always start with one of “Observed”, “Gridded” or “Projected”. When referring to Data in a query, the name must always be given in double quotes. This allows for flexible and therefore clear naming.

Basic usage

How to display observed data on the map

1. Select Data

   On the Select data panel you can select the type of climate data you want to view. You can choose what type of data you want to view, how you want that data to be aggregated on the map and charts and the time range you wish to view the data over.

2. Click “Show on Map”

   The climate data which you have selected will be overlaid on the map.

   The map overlay will show climate data which has been aggregated over time according to the Aggregation option you have selected on the Select data panel.

How to download a printable map image

Click “Download printable image” to download an image of this map to use in reports and presentations. The image is generated on the server, so please be patient as it may take some time to generate depending on the server load.

This image will be in the PNG image format to preserve colours correctly, may be of a different size, and will not display the various map controls. Some other things may not look exactly the same as what you see in the browser, e.g. fonts may differ, depending on the server configuration.

How to generate a chart from the map overlay

1. Select places on the map overlay

    You can click on a single grid on the map or select a range of points by clicking and dragging the mouse or holding the SHIFT key while you click multiple grids.

2. Click “Show chart for selected places”

    A chart window will pop up showing a chart for those places. The chart will show climate data which has been aggregated from each of the selected grids according to the Aggregation option you have selected on the Select data panel.

    Click “Download” on the chart popup window to download the chart image.

    You can resize the Chart popup window to show more detail

    You can add more lines to the chart by simply selecting different data.

    To clear the chart and start a new one, simply close the chart popup window.

How to filter the map overlay

There are two ways to filter the map overlay.

Colour Key

The Colour Key will filter out any places whose value on the map overlay lies outside the range in the Colour Key. However, more powerful filtering is possible with the Filter Box.

Filter Box

The Filter Box accepts simple mathematical and logical expressions. You can refer to any attribute of a place, and the value. The list of attributes depends on what data has been loaded into the system. To see the list of attribute, hover over a place on the map overlay. All the attributes listed in the popup are available in the expression. For example: latitude / longitude elevation and name.

The filter expression will be give a boolean (true/false) value. The expression will be evaluated on each place. If the expression evaluates to true, the place will be shown, otherwise it will not be shown.

Examples

1. Selecting a region by ISO code:

```
ISO_code = "CPV"
```

2. Using the boolean operators "and" and "or".

```
value > 1000 and latitude > 0
```

If no filter has been specified, the Filter Box will show "unfiltered" and all places will be shown.

Special filter functions

Filtering can also use some special filter functions that are described in the table below. These filter functions allow filtering by location.

Special filter function	Effect
within("Area name")	Only shows places within the named area. Multiple area names may be specified, separated by commas.

Simple data comparisons

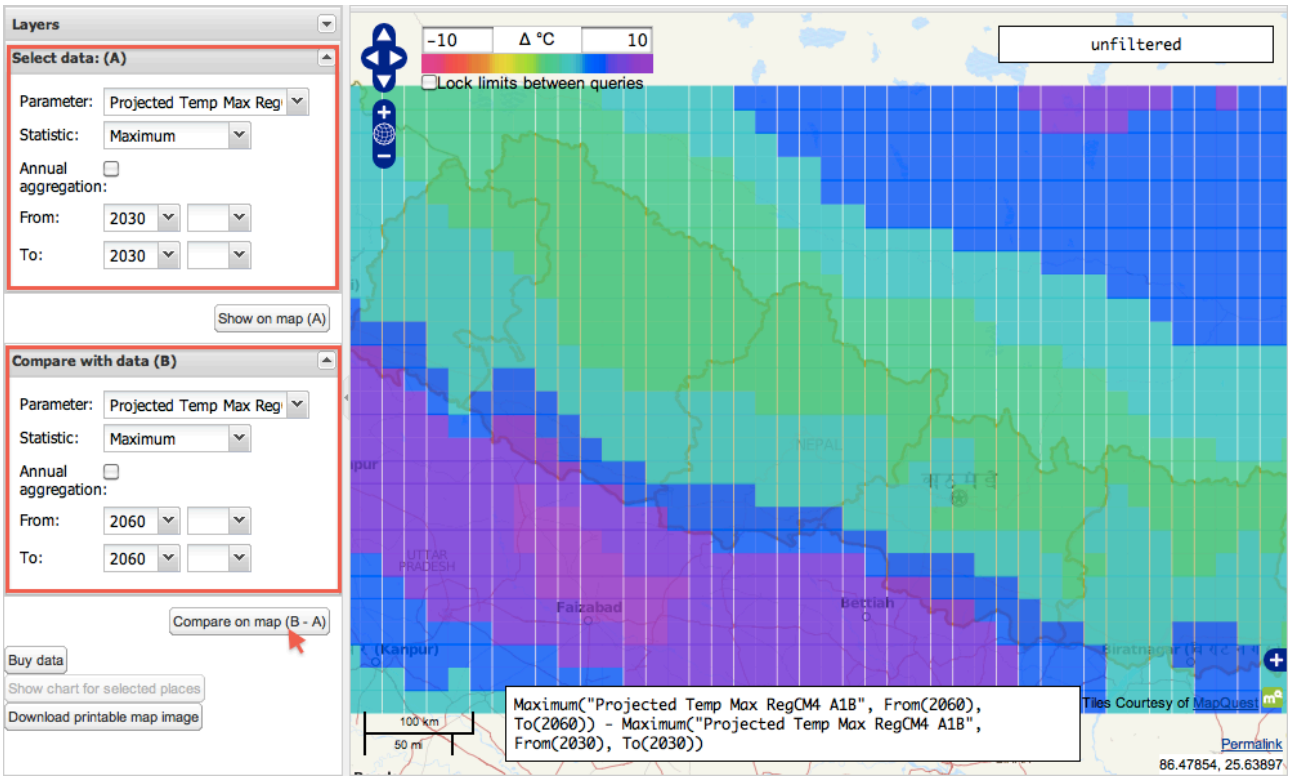
Performing a simple comparison

The Sahana Eden Climate Data Lab allows different climate data to be compared for analysis. These could be the same type of climate data compared over different time periods or different types of climate data.

Example

A meteorologist needs to know how much the maximum yearly temperature will increase between the years 2030 and 2060 to determine the risk of increased flood hazards due to glacial melting.

The Compare with... (subtract from) panel allows the differences between data to be displayed as a map overlay.



Using the "Compare with Data" sub-panel to compare two data sets

Select the two data sets as you would for "Select data". Click "Compare on map (B-A)". A query is generated subtracting the top selection from the bottom.

Note: Charts can also be used to visually compare different types of climate data and climate data from different places. This is done by keeping the plot window open, selecting different climate data and clicking Show chart for selected places. This data will be added to the existing chart. Using the check boxes, the user can combine multiple charts in order to compare different climate data. This is useful for analysis.

Annual aggregation

Explanation

The checkbox “Annual aggregation” allows the user to aggregate monthly values into a single yearly value for each year of the selected time range.

This actually makes no difference to the map overlay, but does make notable differences to the time-series charts, i.e. it aggregates monthly values into a single yearly value:

What difference does the Annual aggregation checkbox make?

Annual aggregation checkbox	Difference to the map overlay	Difference to charts
Checked	No difference - because values displayed on the map overlay must all be aggregated into a single value (single coloured square per place) anyway.	Charts lines will have one value per year, shown as circles joined by lines.
Unchecked		Monthly time series will be shown as just lines without circle markers. Over many years this is often a waveform with a period of one year.

Month selection

Below the “Annual aggregation” checkbox are 13 labelled checkboxes “**D J F M A M J J A S O N D**”. These allow the user to select which months to aggregate. For example, the user may only be interested in yearly values for the summer months only. Thus they might select only **J J A** (June, July and August).

The “Previous December” checkbox

By default, the checkboxes starting from the first **J** (January) until the last **D** (December) are specified. This selects every month in the year.

However, there is another typical use case wherein a user may wish to look at seasonal changes. Typically, the only difference this makes is the special treatment of the December of the previous year. I.e. when we talk about “Winter 2011” we actually mean **December 2010**, January 2011 and February 2011. The first **D** checkbox is allowed to make this possible.

Within the system, to distinguish this concept from the normal concept of December, it is identified with a special name: “**PreviousDecember**”. This name can be used in expressions within the Months() filter. **PrevDec** is a shorter alias of this name.

When the first **D** checkbox is checked, then PreviousDecember is specified in the month filtering and two things happen:

1. The December of the previous year is counted as part of that year.
2. If the date range is specified in terms of years (no months*), then each year starts in December and ends in November. i.e. if the year range is From(2000) To(2011), then the actual dates will be from December 1999 to November 2011.

*Note that when months are specified in the date range (e.g. March 2000 to October 2011), together with PreviousDecember, behaviour is currently undefined.

What difference does checking the months make?

Months selection example	Outcome
D J F M A M J J A S O N D ☐ ☑ ☑ ☑ ☑ ☑ ☑ ☑ ☑ ☑ ☑ ☑ ☑ (Default)	Every month in the year will be aggregated into a single value. E.g. 2011 will use values from Jan 2011 to Dec 2011
D J F M A M J J A S O N D ☑ ☑ ☑ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ **(PreviousDecember specified)**	Only values from the winter months will be aggregated together into a single value. E.g. if the date range is 2000 to 2010, the value for 2000 = **Dec 1999** + Jan 2000 + Feb 2000. The data for December 2010 will be ignored as it now falls outside of the range.
D J F M A M J J A S O N D ☐ ☑ ☑ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☑	The data will differ from the **D J F** case. Values for January, February and December in the same calendar year will be aggregated together.
D J F M A M J J A S O N D ☑ ☑ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☑ ☑ **(PreviousDecember and December)**	Not allowed - system will complain that it doesn’t make sense to aggregate annually using both December and the PreviousDecember. The user interface will not allow both D’s to be checked at the same time.

Flexible data queries

Overview

Internally, the Sahana Eden Climate Data Lab uses a simple, specialised query language which is used to query the database. This language can be used directly to formulate more complex queries than a simple user interface could easily allow. This feature can be used for more advanced statistical analysis such as computing Coefficient of Variation to show the dispersion of the climate data and interpret its reliability.

These query expressions are simple mathematical expressions, similar to those you might write in a spreadsheet. Only queries can be written. The language is deliberately too simple to allow the writing of general programs (this is important for security, as the queries run on the server).

Internally, the output of these expressions is a mapping of keys to values. When generating a map overlay, the keys will be places on the map. When generating a chart, the keys will be time periods. Whether the keys are places or times is implicit and depends on the context of usage but not on the expression itself. Thus, you do not need to modify their query expression to generate a graph or a map overlay.

Queries are shown in the Legend / Query Box

You may have already noticed examples of the data query syntax in the preceding chapters. The box at the bottom of the map shows the expression being evaluated, whilst also serving as a map legend. This is set to an initial expression when the browser first loads the page. It will also be updated every time you use the graphical user interface in the side panel to change the data being displayed. Thus you can use this feature to quickly see examples of the syntax.

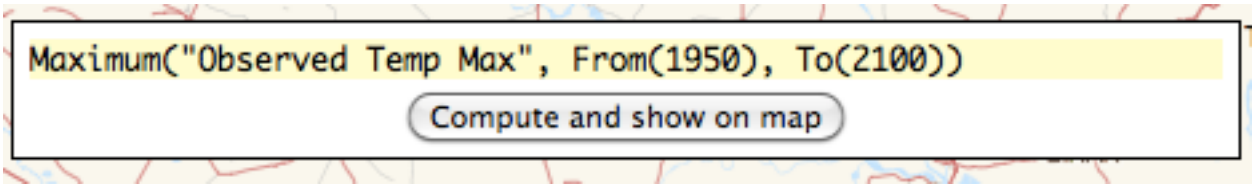
The Legend / Query box. This is an editable box located at the bottom of the map viewer.

Let's break down this example into parts:

Maximum(	"Observed Temp Max",	From(1950),	To(2100)	)
Statistic name. I.e. "Return the maximum value for each key"	Data set name. This is always in double quotes, and always starts with "Observed", "Projected" or "Gridded".	Start date, inclusive. I.e. use values from 1st Jan, 1950	End date, inclusive. I.e. use values until 31st Dec, 2011	Remember to match closing braces.

Editing query expressions

To edit query expressions, simply click with the mouse inside the query box. A flashing cursor should appear. You can now edit the expression. As soon as you start editing, a button will appear labelled “Compute and show on map”. When you are happy with your edited expression, click the button to update the map overlay.



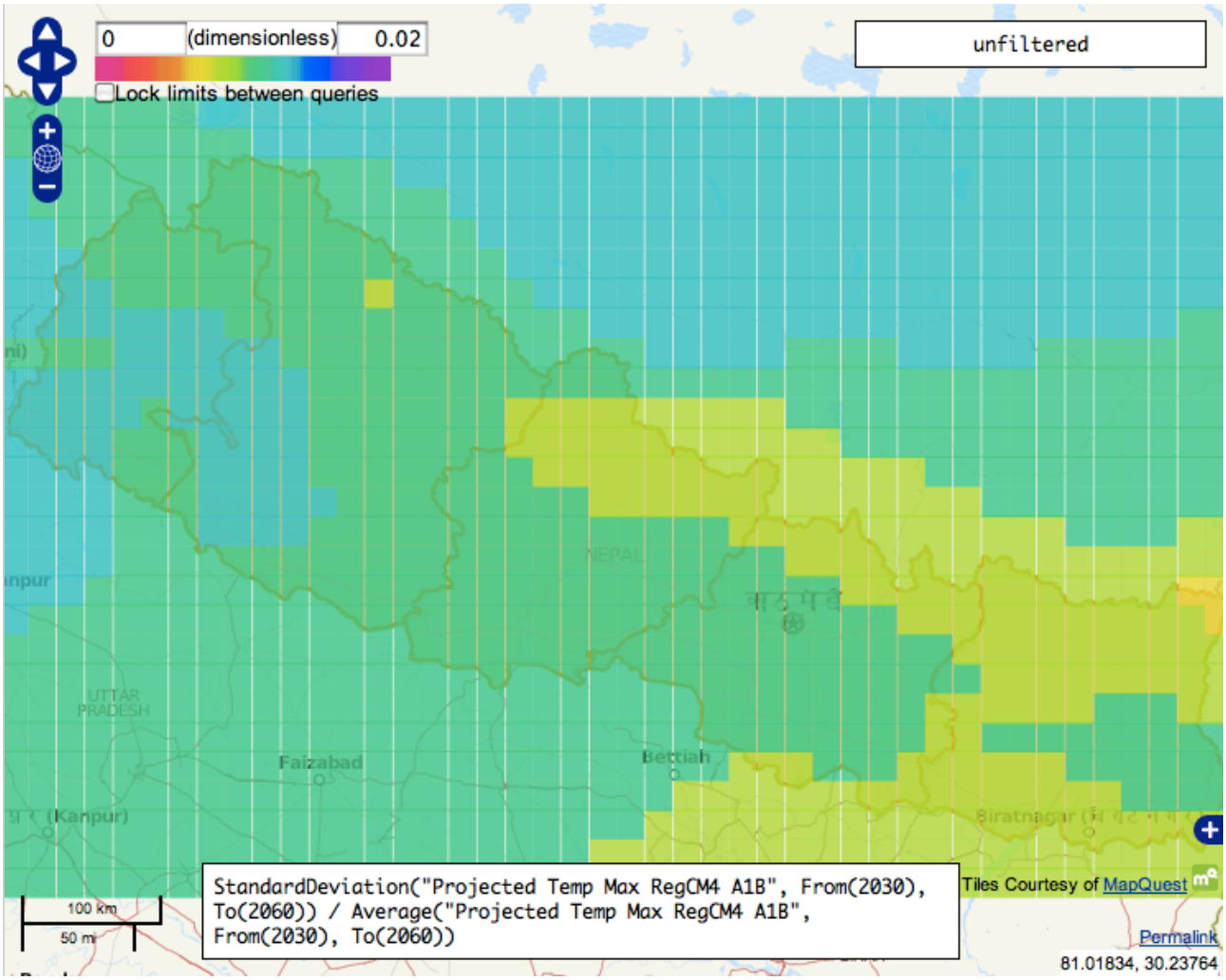
The “Compute and show on map” button. This appears whenever the query has been edited.

Example

A meteorologist is producing a using projected temperature data for 2030-2060 and needs to understand the C.V. of the data.

C.V. is Standard Deviation divided by the mean, so we can enter the expression:

```
StandardDeviation("Projected Temp Max RegCM4 A1B", From(2030), To(2060)) /
          Average("Projected Temp Max RegCM4 A1B", From(2030), To(2060))
```



Directly entering an expression to calculate C.V.

Expressions and operators available in the query syntax

Statistical expressions

These always have a double-quoted data name as their first argument.

Expression	Meaning	Notes
Maximum(*dataset, ...*)	Maximum sample value	
Minimum(*dataset,...*)	Minimum sample value	
Average(*dataset,...*)	Average of the sample values	
StandardDeviation(*dataset, ...*)	Standard deviation of the sample values	Gives a delta value
Sum(*dataset, ...*)	Sum of the sample values.	
Count(*dataset, ...*)	Count of the number of samples.	Gives a dimensionless value

Mathematical operators

Operator	Meaning	Notes
+	Plus	It is an error to add or subtract expressions that use different units.
-	Minus	
*	Multiply	
/	Divide	
^ *n* ^ (1/*n*)	Raise to power Root	Only integral powers or integral ratios are allowed. I.e. *n* must be a whole number, and not a statistical expression. It may be an error if the resulting units do not make sense.

Expressions used inside aggregation expressions

Expression	Meaning	Notes
From(*Year*[, *Month*[, *Day*]])	Specify start date*	If month is not given, January will be used. If day is not given, 1 will be used.
To(*Year*[, *Month*[, *Day*]])	Specify end date*	If month is not given, December will be used. If day is not given, the last day of the month will be used.
Months(...)	Specify which months* to aggregate	Only data from the specified months will be used.

* Months can be specified by name or number: i.e. PrevDec = PreviousDecember = 0, Jan = January = 1, Feb = February = 2, ... Dec = December = 12